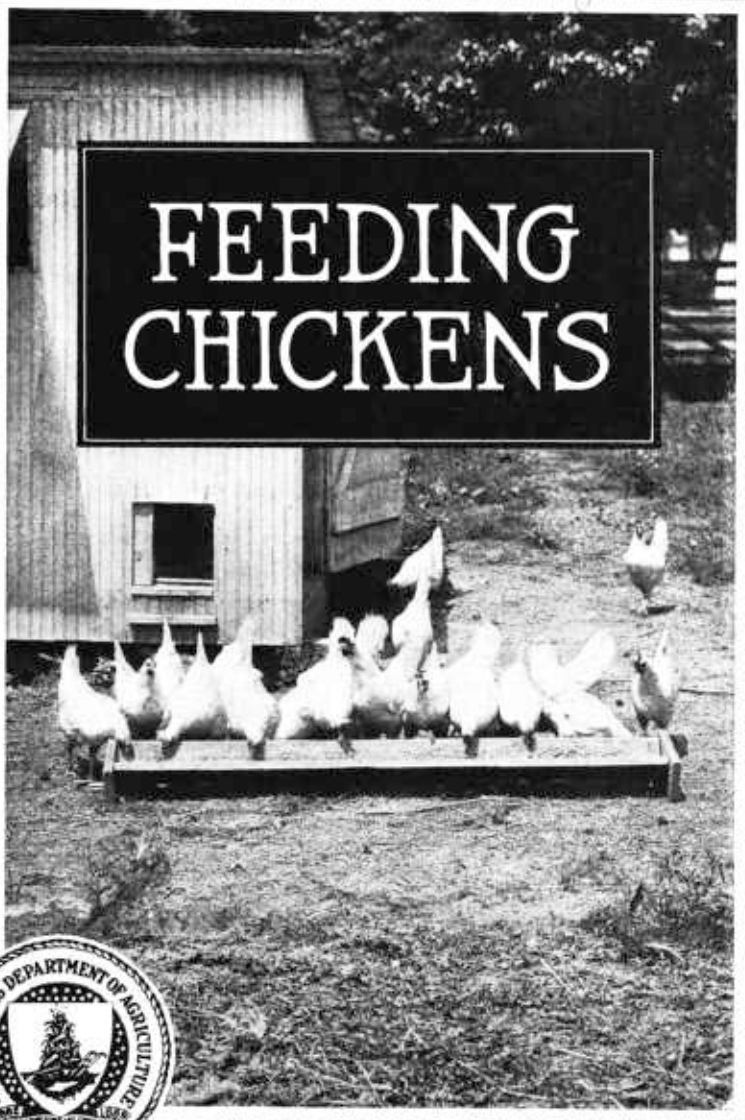
U. S. DEPARTMENT OF AGRICULTURE

FARMERS' BULLETIN No. 1541 rev.
Feb. 1930

FEEDING CHICKENS



EFFICIENT FEEDING PRACTICES are necessary to make poultry raising most profitable and to produce the best quality of products.

The feed is the most important cost factor in raising poultry. Therefore the selection of feeds and the method of feeding are very important matters.

In feeding all classes of poultry a proper balance of the various nutrients is necessary, especially proteins, carbohydrates, minerals, and vitamins.

In this bulletin the relative value of the different nutrients is discussed and methods of feeding chickens for different purposes are outlined.

This bulletin supersedes Farmers' Bulletin 1067, Feeding Hens for Egg Production.

Washington, D. C. Issued October, 1927; revised January, 1930

FEEDING CHICKENS

By M. A. JULL, *Senior Poultry Husbandman*, and A. R. LEE, *Associate Poultry Husbandman, Animal Husbandry Division, Bureau of Animal Industry*

CONTENTS

NUTRITION AND METABOLISM

THE FEEDS CONSUMED by chickens are used in repairing waste and in providing materials for growth, reproduction, and the storing of fat. The complex character of the body of the chicken and of the egg it lays suggests the nature of the feeds needed. The body consists of water, minerals, proteins, carbohydrates, fats, and various other organic substances. The egg consists of the albumen, or the white, a secretion of the glands of the oviduct, and the yolk, which is a real cell. The albumen contains more than 87 per cent water and nearly 11 per cent protein. The other constituents of the albumen are of less importance. The yolk is much more complex than the albumen and contains about 50 per cent water and about 50 per cent solids, which consist of egg oil, protein, carbohydrate, fats, minerals, and other substances. The yolk is also relatively rich in certain vitamins. The shell of the egg consists largely of calcium. The feeds required by chickens must contain these elements in varying quantities and proportions, according to the age of the chicken and the purpose for which it is fed.

Feeds are given to chickens in order that they may be converted into meat and eggs, but before this is possible the chicken must be maintained. Simply for maintenance the ration must furnish, among other things, fuel enough to maintain the body temperature and energy to carry on the vital processes. The normal temperature of the chicken is 106° F. and some of the feed consumed must go to supply heat in order to maintain the normal temperature and also in order that the various body functions may be performed. The process of digesting feed, the movements which take place during respiration, the work performed by the heart, and the movements of the muscles use up energy which must be replaced if life is to continue.

It is not the purpose in this bulletin to enter into a detailed discussion of metabolism. Briefly, it may be said that from the moment that feed is consumed by the chicken it is subject to a continuous series of changes, a portion being utilized and the remainder elim-

inated as feces. A portion of the feed taken into the digestive tract is absorbed and is used in repairing waste, building new tissue, and supplying heat and energy. The nutrients of the feed, the fats, carbohydrates, proteins, and minerals are broken down from complex forms into simpler ones, which are passed into the blood stream and are thus distributed to all parts of the body, where they are again built up into the more complex forms as found in the animal body. This whole process of breaking down and building up again is known as metabolism, and it serves to enable the chicken to maintain life, to grow, store fat, and reproduce.

COMPOSITION OF FEEDS IMPORTANT

In the development of body tissue and in the production of eggs the relative value of the feeds needed by chickens depends somewhat on their composition and digestibility. From the standpoint of composition alone there are essential differences among the feeds.

Practically all the staple grains and the green plants used in poultry feeding have an abundance of carbohydrates and fats; all contain some minerals, most of them are deficient in protein, and many are deficient in vitamins. The percentage of carbohydrates is practically the same in corn, wheat, and barley, while it is somewhat lower in oats and buckwheat. All these staple grains contain about 10 to 12 per cent protein, but they are low in ash constituents. The so-called concentrated feeds, such as meat scrap, fish meal, and gluten meal, are naturally relatively rich in protein but relatively poor in carbohydrates. Because chickens need relatively large quantities of various minerals, such feeds as oyster shells, ground limestone, and raw bone meal are of particular value because they are rich in minerals. The various poultry feeds differ so much in composition that some variety is necessary if chickens are to have a proper balance of the various elements required.

Table 1 at the end of the bulletin gives the composition of various feeds used in chicken-feeding practices and may be used as a reference table in compiling rations.

REQUIREMENTS OF SATISFACTORY RATIONS

The composition of feeds and the digestibility of their nutrients have been determined by chemical science, but, important as these matters are, it has frequently been found impossible to compile rations that would produce the most satisfactory results. During recent years the discovery has been made that the chemical analysis alone does not determine the dietary value of feeds. The systematic feeding of simplified diets to chickens has shown that different rations having the same chemical composition and with similar digestible nutrients frequently produce entirely different results in growth and egg production. It is now known that not only for normal growth, maximum egg production, and the storing of fat but also for health and even life it is not sufficient that chickens receive merely plenty of fat, carbohydrates, and protein.

Recent work has demonstrated that the three most essential requirements of satisfactory rations are; (1) That the protein is not only sufficient in quantity but is also of the right kind; (2) that the

feed contains sufficient quantities of certain vitamins; (3) that there is an adequate supply of the proper minerals.

PROTEIN REQUIREMENTS

Protein is relatively more important than fat and carbohydrates because it is the most difficult to get in sufficient quantities. The egg is relatively rich in protein, but the staple grains do not contain enough, making it necessary to obtain additional supplies from other sources. The required quantities of protein may be obtained from animal or vegetable sources, but animal protein is superior to vegetable protein. Animal protein increases the efficiency of the grain ration, and from practical experience it has been found that the mash part of the ration should contain from about 10 to 20 per cent of feeds rich in protein, depending largely on the age of the stock and the purpose for which it is fed. An excess of protein, however, is to be avoided because it constitutes a heavy tax on the digestive system and is uneconomical because protein can not efficiently take the place of the other nutrients. Protein is usually more expensive than carbohydrates and fat, and care should be exercised to see that no more feed is fed than is necessary.

The principal sources of animal protein are meat scrap, fish meal, and milk. The principal sources of vegetable proteins are soybean meal, peanut meal, cottonseed meal, and gluten meal.

VITAMIN REQUIREMENTS

In addition to the composition, digestibility, and other important qualities of the feeds, evidence is accumulating that they must contain other bodies not protein, nor carbohydrate, nor fat, nor mineral, but of an organic nature without which the fowl can not live. These are called vitamins, and although apparently required in very small quantities they are nevertheless of vital importance. Up to the present time the existence of five vitamins has been determined, and they have been identified as vitamins A, B, C, D, and E.

The first vitamin, A, is a substance necessary for growth. The feeds in which this growth-promoting vitamin is most abundant include cod-liver oil, egg yolk, butterfat, alfalfa and other green feeds, pig liver and kidneys, milk, and some of the cereals, especially yellow corn. Laying hens and growing chicks having an abundance of range and also having access to direct sunlight probably do not require vitamin A to be supplied from a special course, especially if liberal quantities of yellow corn are used in the rations. When the birds are confined, however, which is frequently the case during the winter months, the feeding of limited quantities of some of the feeds rich in vitamin A frequently proves beneficial and in some cases is quite necessary, especially with growing animals. When in concentrated form vitamin A appears to be somewhat unstable and after having been exposed to the air for some time tends to lose its strength.

The second vitamin, B, is a substance which protects against an acute metabolic disease known as beriberi. The vitamin is in milk, eggs, yeast, leaves, seeds, and tubers. As it is so widely distributed in feeds given to chickens, it does not seem necessary to supply additional quantities. Vitamin B has been divided into two vitamins, F and G.

The third vitamin, C, is probably not so important in poultry nutrition as the first two vitamins, inasmuch as it is an antiscorbutic vitamin which prevents the appearance of the scurvy disease in certain mammals.

Vitamin D is known as the antirachitic vitamin because its presence in the ration in sufficient quantities prevents the development of leg weakness, commonly called rickets. When chicks are raised indoors there is usually a lack of proper bone formation, especially in the joints of the legs, if there is a deficiency of vitamin D in the ration. Leg weakness also frequently develops in chicks hatched early in the season, even if they can get outdoors as much as the weather will permit.

Chicks hatched later in the season so that they can run outdoors from hatching time rarely suffer from leg weakness. This is because the ultra-violet rays of the sunlight have the same effect as vitamin D in promoting bone growth. Window glass does not allow the ultra-violet rays to pass through and that is why chicks raised indoors need to have vitamin D added to the ration in some form. A deficiency prevents the utilization of certain essential minerals even if they are present in abundance.

The addition of vitamin D to the ration of breeding hens used for the production of hatching eggs tends to increase the hatchability of the eggs and the chicks are stronger than when there has been a deficiency in the ration of the breeders, especially if they have been confined indoors before and during the breeding season. Cod-liver oil and egg yolk are relatively rich in vitamin D.

Vitamin E, lack of which may cause sterility, is not so well known. Wheat germ is one of the richest sources of this vitamin which is found in most green feeds, in germinated oats, in yellow corn, and in cottonseed and olive oils. Milk contains it in very small quantities, but cod-liver oil is notably lacking in this vitamin.

MINERAL REQUIREMENTS

That a proper supply of mineral matter is of great importance to chickens is shown by feeding rations freed, so far as possible, from the essential minerals, in which case death from mineral starvation frequently results. Mineral matter exists in all the vital parts of the body of the chicken; more than 90 per cent of the mineral matter of the skeleton consists of calcium and phosphorus.

Although nearly all the common feeds given chickens contain minerals, there is usually a deficiency of calcium and phosphorus. Growing chicks need calcium phosphate as a supplement to the grain ration. This can be supplied by adding to the ration small quantities of ground, steamed bone meal and ground limestone. Laying fowls naturally require relatively large quantities of mineral feed, calcium and phosphorus being of greatest importance. The addition of meat scrap and more especially ground, steamed bone meal as well as fish meal will supply any lack of phosphorus. On the other hand, both calcium and phosphorus are more easily taken from the bones of the bird than from the dead bone ash in the feed. Under ordinary circumstances, the feed given a hen is deficient in calcium carbonate, and the need of this mineral is very great in heavy egg production. The functions of calcium are very important and because part of the material for eggshell formation comes from the

bones of the body and part directly or indirectly from the minerals fed, it is imperative to provide at all times a liberal supply of calcium in the form of oyster shells. Milk and alfalfa are also important sources of calcium. A deficiency of calcium supply in the feed causes a decrease in egg production, which may become very pronounced if the ration continues to be deficient in calcium.

Other minerals essential in the ration are sodium, iron, and chlorine, although they are required in very small quantities. Green feeds probably provide iron enough, and common salt supplies the sodium and chlorine if they are otherwise deficient.

FAT AND CARBOHYDRATE REQUIREMENTS

Although the three most important requirements of satisfactory rations have to do with the supply of proteins, vitamins, and minerals, there are other requirements that have to be met and one of these has to do with the fat and carbohydrate requirements. Fats and carbohydrates supply the chicken with material for the formation of fat in the body and for the development of energy.

Most staple grains are relatively rich in carbohydrates and fat, and because they are abundant and easily obtained there seems to be little concern over the normal requirements for poultry-feeding purposes. At the same time the character of the fat in some of the animal feeds may have considerable significance, particularly if an excess of fatty acids is present. Also, since a portion of the carbohydrates consists of fiber, some attention should be given the fiber content of feeds because fowls do not digest fiber so efficiently as mammals, and there seems to be some danger in providing chickens with an excess.

BASIC PRINCIPLES OF FEEDING

Among the various practices in poultry raising, probably there is no greater variation than in respect to rations used, whether in the case of growing chicks, market poultry, laying hens, or breeding stock. Although many farmers and commercial poultry raisers use widely different rations for the different classes of stock, nevertheless there are certain fundamentals in feeding practices which must be followed in order to get the best results. As a matter of fact, so long as certain fundamentals are kept in mind it may not be of such great importance to have exactly certain proportions of certain kinds of grains in the ration. This becomes evident when it is realized that equally high-production records have been obtained in egg-laying contests although the scratch and mash rations used varied considerably. Also, high-production records are obtained on poultry farms as well as in commercial poultry plants in various sections of the country even though the grains used to make up the bulk of the ration may be different.

One of the most important requisites in satisfactory feeding practices is regularity. The growing chicks, market poultry, as well as laying and breeding stock, must be fed regularly or satisfactory results can not be obtained. The palatability of the ration is another requisite, which may be taken care of by using a variety of grains, although the fiber must be kept to the minimum; otherwise the ration will be too bulky. While variety is desirable, both the scratch and

mash rations may be rather simple, using principally the grains most readily obtained. For instance, in the Middle West, corn should be used to a greater extent than any other grain. In other parts of the country, however, it may be possible to substitute wheat or even barley for corn, at least for a part of the year. In California barley is used extensively. Still other grains produced locally, such as kafir, sorghum, and rice, can be used to supplement the ration, frequently with the result of reducing the cost, because locally produced grains are usually cheaper than grains brought in from other sections.

Another factor of importance influencing feeding practices is the effect of the feed on the product. Yellow corn produces a yolk of a darker color than that produced by white corn. Alfalfa tends to produce yolks of a dark-yellow color, and wheat and oats tend to produce light-colored yolks. It is well known that the flavor of eggs may be affected by the kind of feed given. Laying hens kept on bare yards without access to green feed and then fed a highly flavored product, such as onions or geranium leaves, produce eggs with the flavor of those products. If broilers or roasters are fed cod-liver oil in their ration up to killing time, the poultry takes on a distinctly fishy flavor; therefore, the cod-liver-oil feeding should be discontinued about two weeks before the birds are to be killed.

Another factor of considerable importance in feeding practices is the requirement of different rations by various classes of chickens. Growing chicks, for instance, require less protein than do laying hens, and also different minerals.

Sometimes the specific effect of the feed may determine whether it should be included in the ration. For instance, milk is one of the most complete and easily digested feeds. It is valuable for all kinds of chickens. Besides its food value, it also is a great appetizer, and its use increases the quantity of feed consumed. It also serves as a regulator of the digestive system and tends to keep the chickens in good condition. Another illustration of the specific effect of the feed may be cited in the case of feeding green feed to prevent a disease called nutritional roup.

In the following paragraphs a number of rations are submitted which have given satisfaction under practical conditions. Several State experiment stations use somewhat different rations which have also given satisfaction, and poultry raisers are advised to write to the poultry department of their State experiment station for rations recommended in their State.

FEEDING CHICKS

The essential feature of feeding chicks is to obtain maximum growth and to cause as little mortality as possible. To accomplish this the chicks must be fed frequently, but only a small quantity each time. It is very important that chicks should not be allowed to overeat, especially the first two or three weeks. At hatching time the chicks are supplied with a certain quantity of food material in the yolk sac which has been absorbed into the body just prior to hatching; therefore the chicks do not need feed until they are about 48 hours old.

After the chicks are about 48 hours old they should be fed four times daily for the first two or three weeks, and three times daily

thereafter. Regularity in feeding chicks is of very great importance and especially for the first two or three weeks it is very important not at any time to overfeed them. Many different chick rations are used successfully and it can not be said that any one of them is the best ration, although undoubtedly some are superior to others. During the last year or so the all-mash method of feeding chicks has been advocated, and in many cases it has been used with success. The use of all-mash feed for baby chicks for at least the first two or three weeks is advised. Scratch feed can then be added to the chick ration to advantage. It has been demonstrated that chicks will do well when their ration is made up entirely of mash, no scratch grains being provided. It is felt, however, that for the average poultry raiser the feeding of scratch grains is still to be advocated.

While a variety of rations has been used successfully, three things must always be kept in mind: (1) The feeds used to supply protein should be of the highest possible quality; (2) there must be an adequate supply of the right kind of minerals, and (3) a liberal supply of vitamin D must be given in order to enable the chicks to make use of the mineral feeds for the purpose of bone formation as well as to provide for best conditions of growth.

With only a few chicks it is less trouble to purchase commercial chick feeds, and even where there are large numbers it is sometimes cheaper to buy the prepared feeds than to buy the grains separately and mix them. Commercial mixtures should be examined carefully and the quality guaranteed before they are purchased. The competition among feed-manufacturing companies has become so keen in recent years that the quality of many brands of prepared feeds is good.

Besides the grains, chicks need an abundant supply of green feed, which is most readily supplied by keeping the chicks on good grass range, but if the grass gets dry, other green feed can best be supplied in the form of sprouted oats, lawn clippings, or ground alfalfa, provided the alfalfa was of good quality when cured. Milk in some form is one of the very best of chick feeds and should be supplied whenever possible. The particular form in which milk is used does not seem to matter very much. Mineral feed of some kind is also important in order to supply the chicks with plenty of bone-forming material. Minerals can be supplied by adding steamed bone meal.

Good chick mashes for the first two weeks may be made up as follows:

No. 1	Parts, by weight
Yellow corn meal	40
Rolled oats	20
Bran	20
Middlings	10
Sifted meat scrap	10
Total (protein 17.2 per cent)	100

No. 2	Parts, by weight
Yellow corn meal	40
Rolled oats	20
Bran	20
Middlings	10
Dried milk (34.6 per cent protein)	10
Total (protein, 15.2 per cent)	100

These mixtures may be fed in flat troughs (fig. 1) four times daily for the first two or three weeks and then fed with a mixture of equal parts of finely cracked corn and cracked wheat. For the first few days hard-boiled, infertile eggs may be mixed with either mash or milk, in which case the meat scrap may be reduced one-half. Care should be taken not to overfeed at any time.

In the case of chicks hatched early in the season and when they have not much access to the direct rays of the sun (fig. 2) or can not get much green feed, they frequently show early signs of leg weakness. A practical method of avoiding this condition is to feed a tested brand of cod-liver oil with the mash. The proper amount of cod-liver oil to use seems to be from 1 to 2 per cent of the mash ration, that is, mix 1 pint or 1 quart of cod-liver oil with every 98 pounds of mash. Make up at one time only enough mash with cod-liver oil for two weeks' feeding. The oil should be mixed with a small quantity of the mash and then incorporated with the whole lot. The oil kept on hand for future use should be kept in tightly stoppered bottles or cans.

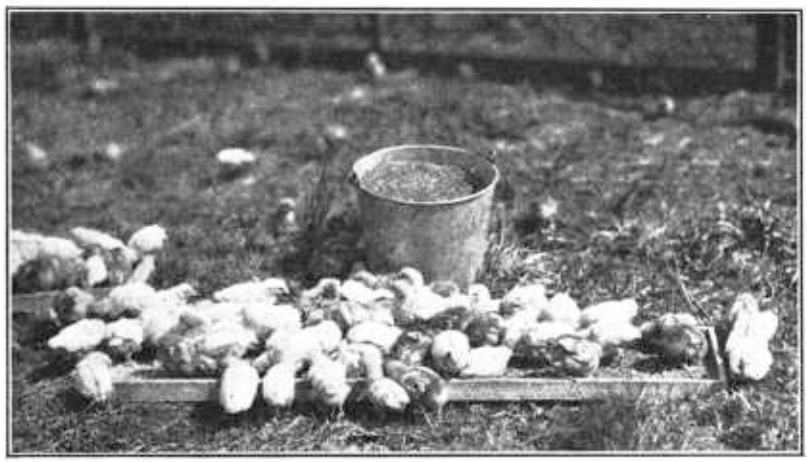


FIGURE 1.—Feeding chicks mash in a flat trough, with sides to prevent waste. The trough should be large enough to give the chicks plenty of room for feeding

When the chicks are from 2 to 3 weeks old, one of these mashes may be used:

No. 1	Parts, by weight
Yellow corn meal	40
Bran	20
Middlings	20
Meat scrap (53.9 per cent protein)	10
Bone meal	5
Alfalfa-leaf meal	4
Salt	1
Total (protein, 17.6 per cent)	100

No. 2	Parts, by weight
Yellow corn meal	40
Middlings	15
Bran	12
Rolled oats	10
Meat scrap (53.9 per cent protein)	10
Dried milk (34.6 per cent protein)	5
Alfalfa-leaf meal	4
Bone meal	3
Salt	1
Total (protein, 18.3 per cent)	100

Either of these mashes may be placed in hoppers (fig. 3) kept open at all times or it may be fed as a moist, crumbly mash once daily, feeding suitable chick grains twice a day. Where a few hundred or more chicks are being raised, dry-mash feeding requires much less time than wet-mash feeding. Also, in dry-mash feeding all chicks are more sure of getting their proper share of feed. The self-feed-

ing hoppers should be so constructed as to waste no mash. With the dry mash the chicks are fed two parts of cracked corn and one part of wheat as a scratch ration.

FIGURE 2.—Getting the chicks out in the sunlight will help to prevent rickets and the chicks will get green feed, which tends to promote growth and keep them in good health. The soil over which the chicks range should be free from worm eggs and disease organisms. Use land on which chicks were not raised the year before

When the chicks are 8 or 10 weeks old they will eat whole wheat and cracked corn, so that the small-sized chick feeds can be eliminated and the chicks fed the scratch grains twice a day.

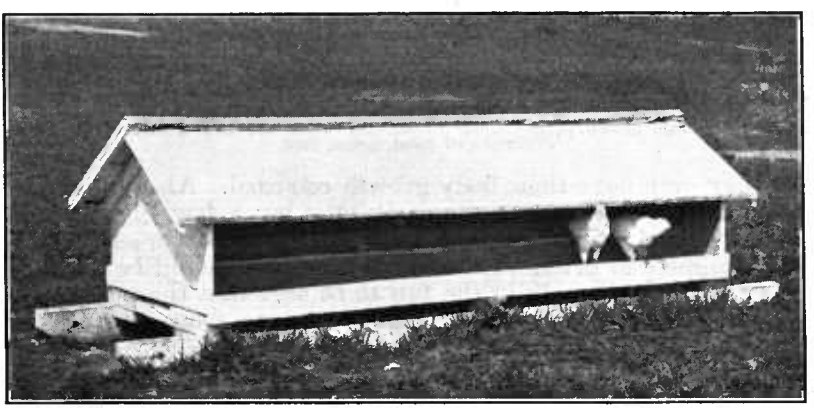


FIGURE 3.—An outdoor, dry-mash hopper for growing chicks. Keeping dry mash before the chicks all the time promotes rapid growth

The chicks' growth can be hastened if they have sour milk, skim milk, or buttermilk to drink in addition to the grain feeds and green feed. (Fig. 4.) Milk is splendid to mix with the mash if wet-mash feeding is preferred.

Considerable care must be exercised in feeding the pullets as they approach maturity. The cockerels should have been separated from the pullets at about 8 to 10 weeks of age, depending on the breed, in the case of the lighter breeds the cockerels being separated earlier than in the case of the heavier breeds. Many of the cockerels may be sold as broilers at the time they are separated or, in the case of the heavier breeds, they may be kept over to be sold later as roasters.

In any case the pullets will do better if they are handled separately, and as they approach maturity they should be fed carefully in order to get them into laying condition at about the right time of the year. If there is a tendency for the pullets to start laying too early, it would be well to reduce the amount of protein in their ration, and it may also be advisable to take away the normal supply of milk. Pullets that commence to lay too early—from 4 to 5 months of age—are inclined to lay very small eggs, and because they began to lay so

FIGURE 4.—Kale grown in the fields where the chicks are raised insures an ample supply of good, green feed

early may even have their body growth retarded. Also, pullets that are allowed to start laying too early may lay a few eggs and then take a rest and go into a molt, thus failing to lay when eggs are usually highest in price. Therefore, every care should be taken late in the summer and early in the fall to be sure that the pullets get a good, growing ration that will enable them to come into egg production any time in October.

FEEDING MARKET POULTRY

In the raising of chickens, whether under ordinary farm or commercial conditions, there is always a certain proportion above those used for laying and breeding purposes which it is necessary to prepare for market. During recent years, however, so much attention has been given to the question of breeding for egg production that it is quite possible that the best interests of the fattening industry have

been sacrificed to some extent at least. However important may be the matter of producing heavy-laying strains, there will always be a large proportion of chickens other than those used for breeding purposes for which it is desirable to develop the most efficient means of preparing for market.

Fattening is a finishing process designed to prepare chickens for human consumption in the most economical way. The main object in fattening is to improve the quality of the lean meat, the accumulation of fatty tissue as such being of secondary importance. When a chicken has been properly fattened, much of the water in the flesh is replaced by oil, so that when the chicken is cooked the flesh becomes tender and juicy. Improvement in the quality of market chickens

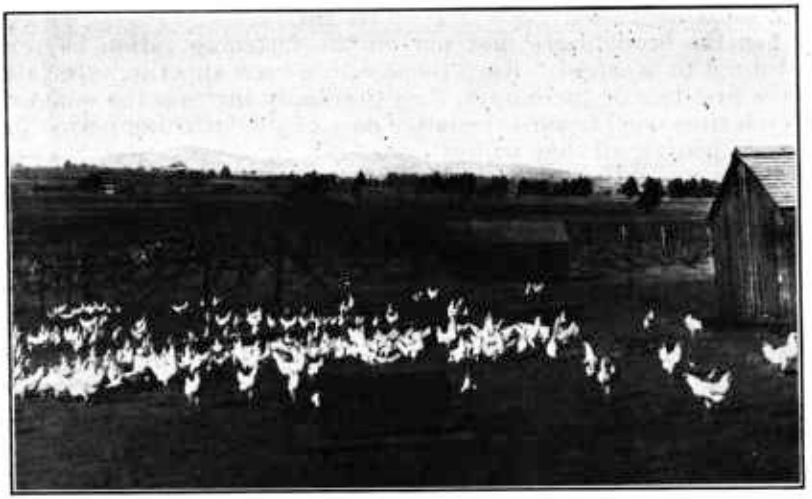


FIGURE 5.—Fattening broilers in a yard for a few days prior to marketing produces better finish

leads to increased consumption, which in turn leads to increased demand for prime fattened stock, thus creating a tendency for the greater improvement of the poultry industry.

FEEDING BROILERS

Broilers are young chickens weighing approximately from one-half to 2½ pounds each, and are usually sold from early in the spring until late in the summer, with the best prices obtainable early in the season. It is frequently advantageous, therefore, to dispose of the surplus cockerels as broilers as early as possible. They can be sold either direct from the range or they can be fattened for a week or two before being marketed. Whether it is advisable to fatten them depends very largely on the condition of the birds.

Frequently, growing chickens on range are in excellent flesh, especially where they have been fed properly. Under such circumstances it is often advisable to sell them direct from the range rather than try to fatten them. On the other hand, if the chickens have been growing very fast and have well-developed frames but are thin, it would be advisable to fatten them for a short period. For this purpose they could be inclosed in a small yard (fig. 5) or placed

in a pen of some kind, or even put into fattening batteries, described later.

Suitable fattening rations may be made up of a variety of grains, two good rations being as follows:

No. 1	Parts, by weight
Corn meal	6
Rolled oats	3
Middlings	1

No. 2	Parts, by weight
Corn meal	6
Ground oats, without hulls	2
Middlings	2

Feed these rations with milk, using 2 pounds of milk to 1 pound of mash. If liquid milk is not fed, add 1 part of dried milk or one-half part of meat scrap to the mash. Much better results are obtained in fattening chickens of all ages when milk is used in the fattening ration.

When the broilers are first put on the fattening ration be very careful not to overfeed. Keep them with a keen appetite, especially for the first two or three days, then gradually increase the quantity fed each time until toward the latter part of the fattening period the birds are getting all they will eat.

Broilers are raised extensively in battery brooders in which the chickens are kept continually until they are marketed. All-mash rations are fed in battery brooding and from 1 to 2 per cent of cod-liver oil is mixed in the mash every 10 days. This mash is kept continuously before the chickens and a 14-hour feeding day is provided by the use of artificial lights during the winter months. A good, all-mash feed for broiler raising may be made as follows:

	Parts, by weight
Yellow corn meal	40
Ground wheat	22
Corn-gluten meal	10
Dried buttermilk	10
Meat scrap	10
Bone meal	3
Alfalfa-leaf meal	2.5
Yeast	2
Salt	0.5
Total	100

FATTENING ROASTERS

Many farmers in different parts of the country may not be in position to fatten their roasters to advantage, because prices received may not pay for the costs of fattening. One should consider the cost of the grains used in feeding during the fattening period and the cost of labor. Furthermore, unless the farmer can feed his birds properly during the fattening period, it would be advisable for him not to try to fatten them at all. Then, again, many farmers have not sufficiently good market facilities to dispose of fattened birds to advantage. Under such circumstances, it is frequently advisable for the farmer not to fatten his surplus stock but to sell direct from the range in an unfinished condition.

Where farmers can market their poultry direct to consumers or where they can obtain prices above unfattened stock to justify fattening, the following information on general fattening practice should be kept in mind.

The best time to fatten roasters is in the fall in order to take advantage of the market situation and the cool weather. At that time of the year well-fattened, fresh-killed poultry commands relatively

the highest price, particularly just prior to the Thanksgiving and Christmas holidays.

Roasters are usually fattened in one of four ways: (1) On the range, (2) in pens, (3) in fattening crates, or (4) in fattening batteries. The range method is the one usually employed on most farms, although, as in the case of broilers, the cockerels sometimes are confined to pens. The choice between these two methods depends largely on local circumstances, although birds fattened in pens require more careful feeding than birds on range. In crate fattening, from 6 to 10 birds are confined in a small crate and fed for a period, usually, of from 6 to 14 days. The birds get no exercise and consequently utilize more of the feed for flesh production. This is a desirable method of fattening roasters where a farmer is in position to sell dressed birds direct to consumers. The fattening of roasters

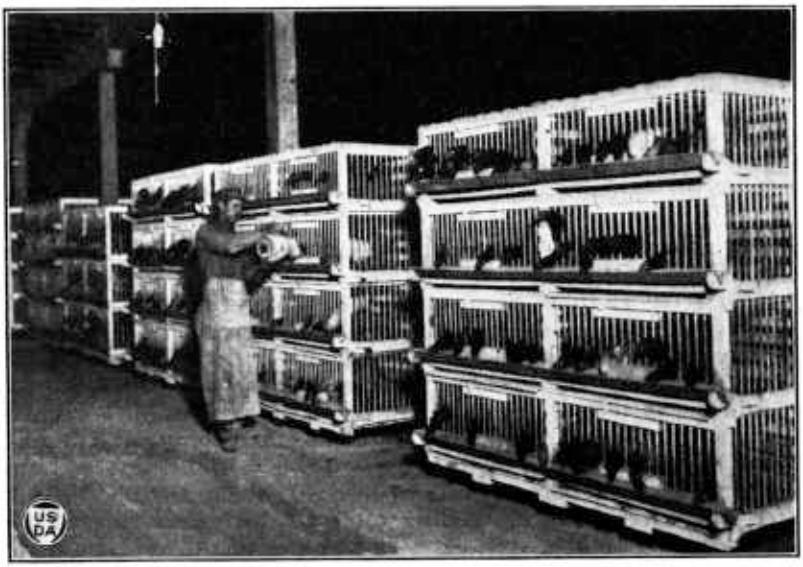


FIGURE 6.—Finishing or fattening poultry in "batteries" is an important activity in most modern poultry-packing establishments

in batteries is practiced in commercial packing plants where birds are fattened by the thousands. As a matter of fact, broilers, fryers, and old hens, as well as roasters, are frequently fattened in batteries.

The batteries are usually built in tiers and hold a varying number of chickens, depending on the number of compartments and tiers. The batteries are made of wood or steel, usually the latter, and most batteries consist of 16 compartments, 8 on each side, arranged in 4 tiers, one above the other. (Fig. 6.) The compartments have wire bottoms with a galvanized pan underneath so that the droppings fall through the wire bottom into the pan, which is cleaned regularly. The batteries are usually mounted on casters and can be moved readily from the fattening to the killing room. Each compartment has a capacity of from 6 to 10 birds, depending on their size; and many of the large fattening establishments have a fattening capacity of from 10,000 to 50,000 or more birds at one time.

In the commercial fattening of chickens ground grains only are used because they can be mixed with milk and fed more easily than whole grains. Moreover, the feeding of ground grains also produces better flesh than whole grains. The ground grains used to make up the fattening rations are usually corn meal, oatmeal, low-grade flour, middlings, and finely ground oats. Various mixtures of these grains give satisfaction, but the actual price of each grain at any particular time determines its value as a fattening feed.

No. 1	Parts, by weight	No. 2	Parts, by weight
Corn meal	6	Corn meal	6
Rolled oats	3½	Ground oats, without hulls	2½
Middlings	½	Middlings	1½

These ground feeds should be mixed thoroughly and the mixture fed with milk. Milk is an excellent feed for fattening chickens. It tends to develop the tissue and improve the quality of the meat. The proportion of milk to the mash mixture is about 2 pounds of milk to 1 pound of mash. If dried milk is used, include 15 pounds in 100 pounds of mash and mix with water. Water is given the chickens freely at the beginning and at the end of the fattening period, and just prior to killing a liberal quantity should be given them in order to flush out the intestines.

Great care should be taken not to feed the birds too much during the first 4 days of the fattening period. Feed very lightly twice a day for about the first 2 days then for the rest of the period feed them all they will eat twice a day, but do not leave feed before them. Gains of from 15 to 35 per cent are made in fattening chickens, the highest gains being made on broilers and the lowest on roasters. The length of time required to fatten poultry properly depends very largely on the age and fleshing condition of the birds when they are put into the fattening pen, crate, or battery. Young birds require a longer period for fattening than old ones. At commercial fattening plants the fattening period is usually from 6 to 10 days. Experienced, private fatteners sometimes feed for from 2 to 3 weeks, but under such circumstances feeding must be done very carefully, especially during the third week. The proper length of time to feed any particular lot of chickens can be determined best by observing the condition of fleshing from day to day.

FATTENING OLD HENS AND COCKS

Every year practically from one-third to one-half of the laying flock is culled, and most of the breeding males are sold after the breeding season is over. Both classes of stock are usually in good condition at time of culling and do not require extra fattening. Birds that are in thin condition, however, may be fattened for about one week on the ration used for fattening roasters.

FEEDING LAYING HENS

The all-important problem in feeding laying hens is to get the largest possible returns in egg production at the least possible expense. The cost of the feed consumed and the price of eggs are therefore the two most important factors determining profits in egg production. The farmer or poultryman can not very well control prices, but he

can control egg production. Egg prices are highest during the fall and early winter months, and every poultry raiser should realize that if he gets good egg production then it will pay him well. Fall and early winter production is the keynote to greatest profits. Usually, pullets should commence laying in October.

The usual advance in the price of eggs, particularly fresh eggs, during the fall of the year, is due largely to natural causes. The molting of the yearling stock shuts out this source of production, leaving pullets practically as the only source of fresh eggs at that time. Pullets, particularly of the heavier breeds, do not generally commence laying before they are well developed, and if for any reason most of them have been hatched late or have not been cared for properly during the growing season, a scarcity of fresh eggs is sure to result.

The pullets must be well matured before commencing to lay and they must have well-developed bodies. Undeveloped and immature pullets are very common in many farm flocks late in the fall and early in winter. All pullets should be well matured and in good condition by about the first of October, and they should be put into their laying pens in September in order to be accustomed to their new place and changed conditions when ready to lay. Well-matured pullets of good health and vitality should be the first consideration in building up a laying flock.

IMPORTANT FACTORS IN EGG PRODUCTION

Maximum egg production is largely controlled by the breeding of the stock as well as by the kinds of feeds given and the method of feeding. Stock that has been bred for egg production is necessary and it must be well managed, including proper housing and good feeding. Breeding and housing problems are discussed in other bulletins, and as this bulletin deals exclusively with feeding problems it will be assumed that other conditions are such as to produce best results.

Among the several factors affecting the cost of producing eggs feed is the most important, since it normally represents from one-half to two-thirds of the total cost of egg production. Therefore the kinds of feeds given and the method of feeding are very important matters. At the same time, it can not be said that there is any best method of feeding the laying stock, because flock averages of 150 eggs per bird have been obtained when different rations and different methods of feeding have been used. On the other hand, there are general principles which apply in feeding practice, and it is possible to suggest rations which should give satisfactory results under average conditions.

FEED REQUIREMENTS

Laying hens should be fed a ration consisting of scratch grains, mashes containing animal feed, mineral feed, green feed, grit, and drink. Recent experimental work has shown, however, that scratch grains may be omitted from the ration, but until the results obtained are substantiated by more extensive feeding trials, it seems advisable to recommend for the average poultry raiser those rations that have been satisfactory under varying conditions.

The staple grains used in feeding layers are necessary to supply the carbohydrates and fats, though they are deficient in protein and

minerals and sometimes are deficient in vitamins. Mashes have a particular value in feeding practice because it is possible to incorporate in them certain feeds rich in protein and minerals.

ANIMAL FEED AND MILK

Some kind of animal feed is desirable in order to get best results in egg production and also to keep the birds in good condition. Animal feed is necessary because most of the staple grains do not contain sufficient quantities of protein to supply the hen with her normal requirements. For that reason, meat scrap or fish meal is usually used in the dry or wet mash rations. Whether meat scrap or fish meal is used, it should be of the highest possible quality. Meat scrap differs in the quantity of protein it contains, and grades containing from 50 to 55 per cent protein are most commonly used. These high-protein feeds vary greatly in their protein content, which should be considered in balancing rations and also in the purchase of the feeds. Fish meal and meat scrap with the same protein content are usually considered to be of about equal feeding value. Both these products also furnish considerable desirable minerals. The proteins of milk are more easily digested, and consequently more efficient than the proteins of meat or fish. Skim milk is rich in protein and ash or mineral matter and is of special value in building up the muscles and bones. Condensed or concentrated buttermilk contains from 10 to 14 per cent protein, and dried buttermilk usually contains from 30 to 35 per cent. The cost of protein in milk is much higher than in meat scrap or other similar feeds. Milk is readily digested, however, and has a decided tonic value. Although the protein in milk is valuable, its greatest use is probably as a supplement to the regular grain rations.

MINERALS

Birds need more mineral feed in proportion to their total feed requirements than most other classes of animals. This is primarily because the eggshell is largely composed of mineral matter in the form of calcium, and also because the skeleton of the bird requires considerable proportions of various kinds of minerals to keep it in repair. Mineral feed is best supplied in the form of crushed oyster shells, or high-grade limestone, which are considered of about equal value as a source of the calcium for eggshell formation. The shells or limestone should be kept before the hens at all times. Steamed bone meal may also be used to advantage, especially to supply the phosphates, and is usually mixed in with the mash ration. Lime and phosphorus, which are very important in feeding for egg production, are two minerals in steamed bone meal, and the content of from 45 to 50 per cent of phosphate of lime from bones serves the hen well in building up her skeleton and furnishing feathers as well as in making eggs.

GREEN FEED

Green feed should be made available for laying stock at all times, and if the birds are not on grass or alfalfa range, green feed can be supplied daily in the form of germinated oats, kale, cabbage, cut

clover, or alfalfa. Feeding the layers green feed tends to keep them in better health and to promote egg production. Green feeds are one of the best sources of vitamins for poultry. Even when mangels or cabbages are fed daily the chickens do not get green feed enough. Mangels and turnips provide some succulence, but very little green feed. Cabbages are not nearly so good as well-cured alfalfa. When cabbages are available at reasonable cost, some may be fed every day, but good-quality alfalfa also should be supplied.

Alfalfa is valuable, not so much because of its protein content, as formerly believed, but because alfalfa leaves are rich in minerals and vitamins, which are lacking in the mash ration. The minerals contained in alfalfa leaves supplement the inorganic deficiencies of the grains, and the fact that alfalfa is also rich in vitamin A makes it doubly valuable for winter egg production. It is also well to give the layers a daily supply of germinated oats. Pails, or small tubs or tables, with small holes in the bottom, are excellent for sprouting purposes. Soak a small quantity of oats in a pail for 24 hours and then dump them into a second pail, or spread them on the sprouting table. Moisten them slightly and the next day dump them into a third paid or move them along the table. Do this with each supply required for a daily feeding for five days, at the end of which time the germinated oats are ready for feeding. The room must be heated in cool weather to allow the grain to germinate. Oats may also be germinated in burlap sacks by soaking the sacks of oats in water for 24 hours and then piling the bags together to hasten the process. The sacks may be completely or partly filled, depending on the quantity of sprouted oats needed. A liberal supply of green feed daily provides the hens with the required succulence in the ration and tends to keep them in better physical condition and keep up egg production.

GRIT

In order that chickens may make the most efficient use of their feed, some form of grit may be fed. The feed consumed by chickens is ground in the gizzard and in order for it to be ground most efficiently, pieces of grit or small gravel should be present. This can easily be provided by purchasing one of the different brands of grit on the market or by providing the birds with gravel.

WATER AND MILK

When hens are laying well they consume large quantities of water. Fresh water should be supplied daily and the layers should never be in need of it or egg production will suffer. Milk also serves as a liquid feed. It contains lactic acid, is a great appetizer, and its use will increase materially the quantity of feed consumed. It also serves as a regulator of the chickens' digestive system and keeps them in the best of condition. Condensed or concentrated buttermilk is an excellent poultry feed and is now used extensively for practically all classes of chickens. This product is usually marketed in barrels or kegs, and may be fed either in a diluted form by adding 3 or 4 parts of water to 1 part buttermilk and given as a drink, or fed as purchased, in V-shaped troughs. For the latter method, feed at the rate of 3 pounds per 100 laying hens.

RECOMMENDED RATIONS FOR LAYING STOCK

A good scratch mixture may be made up of:

	Parts, by weight
Yellow corn	2
Wheat	1
Good, sound oats	1

This is a good mixture for most of the year, although it may be changed to equal parts of the three grains mentioned for the warm, summer months, as corn is very fattening. Oats of poor quality should not be fed, because they contain too much fiber. Only grains of good quality should be used, as moldy or musty feeds make the stock sick. This scratch ration should be fed morning and evening

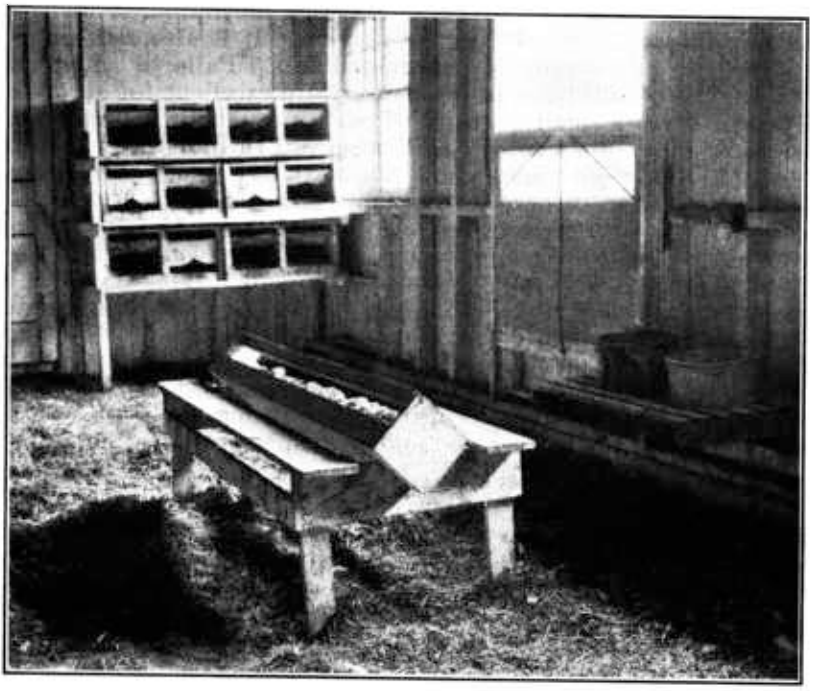


FIGURE 7.—A very satisfactory type of dry-mash hopper which makes the mash available at all times, keeps the mash clean, and avoids waste. Note the water stand at the right of the mash hopper

either in the litter or in troughs. There are parts of the country, however, where corn is rather difficult to get or where other grains are cheaper. Barley is used in some localities instead of yellow corn. In still other sections locally grown grains, such as kafir or sorghum, are sometimes used to supplement the scratch ration. The morning feed should be a light one so that the hens will be kept scratching most of the morning. The evening feed of scratch grain should be sufficient to have the birds go to roost with full crops.

The mash ration (fig. 7) is made up of a mixture of ground grains to which should be added feeds rich in protein and feeds rich in minerals. The former are to make up for the deficiency of protein in the ground grains and the latter are particularly good for supplying mineral elements for the formation of the eggshell and the

development of the bones and feathers. Four good mashes are suggested as follows:

Mashes for laying hens

No. 1	Parts, by weight
Yellow corn meal	40
Ground oats	10
Middlings	10
Bran	10
Meat scrap or fish meal	20
Alfalfa-leaf meal	5
Steamed bone meal	2½
Ground limestone	2½
Total (protein, 20.6 per cent)	100

No. 2	Parts, by weight
Yellow corn meal	45
Ground oats	10
Middlings	10
Bran	10
Meat scrap (53.9 per cent protein)	15
Alfalfa meal	5
Steamed bone meal	2
Ground limestone	2
Salt	1
Total (protein, 18.2 per cent)	100

No. 3	
Yellow corn meal	35
Ground oats	15
Middlings	10
Bran	7
Meat scrap (53.9 per cent protein)	7
Fish meal (56.1 per cent protein)	7
Dried milk (34.6 per cent protein)	7
Alfalfa-leaf meal	5
Steamed bone meal	4
Ground limestone	2
Salt	1
Total (protein, 19.9 per cent)	100

No. 4	
Yellow corn meal	30
Ground oats	10
Middlings	10
Bran	10
Meat scrap (53.9 per cent protein)	10
Alfalfa meal	10
Cottonseed meal	10
Steamed bone meal	5
Ground limestone	4
Salt	1
Total (protein, 19.7 per cent)	100

Mashes Nos. 1 and 3 are very similar, and in actual practice there probably would be but little choice. No. 2 is low in both protein and minerals and probably would produce fewer eggs than the others. Yellow corn meal is preferable to white corn meal because it contains more of the vitamin A. Mashes Nos. 1, 2, and 4 should be supplemented with skim milk given as a drink or concentrated buttermilk fed daily at the rate of 3 pounds for every 100 birds. Mashes Nos. 2, 3, and 4 each contain 1 per cent of salt, which supplies sodium and chlorine. Mash No. 3 contains 7 per cent fish meal as well as 7 per cent meat scrap, the fish meal supplying more phosphate than the meat scrap. Mash No. 3 also contains 7 per cent of dried milk, which makes it more expensive but it should be a desirable mash where milk in some other form is difficult to obtain. Mash No. 4 uses cottonseed meal to supply vegetable protein, which, however, is not so good as animal protein. Care should be used in feeding cottonseed meal, as it sometimes affects the quality of the eggs. However, in case a vegetable-protein feed like cottonseed meal, soybean meal, or gluten meal can be procured at considerably less cost than an animal-protein feed like meat scrap or fish meal, then the ration should have an abundance of mineral feed.

In case the laying hens are confined in the laying house, or if there is lack of sunshine, the rations given above can be improved in their feeding value by having from 1 to 2 per cent of cod-liver oil added. The value of cod-liver oil for laying hens has not been conclusively demonstrated, but it seems desirable to add it to the ration

when hens are kept confined to the poultry house. Not more than two weeks' supply of feed should be mixed with this oil. The oil should be mixed with a small quantity of the feed and then incorporated with the entire mixture. The oil may be mixed in the scratch feed instead of in the mash, if preferred.

The mash mixture may be fed either in a dry form or as a moist mash. When fed as a dry mash it may be placed in self-feeding hoppers where the birds can help themselves at any time. This method of feeding mash rations saves labor and also insures all the hens getting a fair share of the food daily. On the other hand, the mash may be fed moistened with either water or skim milk. This method has the advantage of being somewhat more palatable than the dry mash, and the birds may eat more, thus increasing egg production. At the same time care should be taken not to overfeed on moist mash; otherwise the birds will have a tendency to get too fat, this being especially true of the larger breeds. Probably the most satisfactory way of feeding the mash ration is to keep the dry mash in self-feeding hoppers at all times and, in addition, to feed limited quantities of moist mash in V-shaped troughs every day.

FEEDING PRACTICES

Instead of using the scratch and mash rations suggested above many farmers use commercial scratch and mash rations, of which there are a number of good ones on the market. Using commercially prepared scratch and mash rations saves a great deal of labor, and with a flock of a few hundred birds this is an important factor.

The quantity of feed consumed by laying hens is affected by a variety of factors, chief of which include the kind of feed supplied, the size of the hens, and to a certain extent the number of eggs laid. A ration consisting of a variety of grains usually induces greater consumption than when one grain is fed. If artificial lights are used extra feed must be given after dark and the drinking water made available for early morning use. Leghorns and similar breeds, which are smaller than the general-purpose breeds—Plymouth Rocks, Rhode Island Reds, Wyandottes, and Orpingtons—consume less feed a year than birds of the larger breeds. Usually birds bred for high egg production consume slightly more feed than less well-bred birds of the same size. From data submitted by a number of experiment stations it is found that Leghorns laying an average of approximately 150 eggs per bird consume from 70 to 85 pounds of grain feed a year, and that general-purpose breeds with the same production consume about 80 to 95 pounds a year.

Under ordinary circumstances the regular method of feeding the laying stock is to feed scratch grain morning and evening, dry mash in self-feeding hoppers or wet mash in V-shaped troughs, or a combination of dry and wet mash, green feed, such as kale or germinated oats daily, oyster shells and grits in self-feeding hoppers, and water and milk in some form every day. Leghorns and similar breeds require approximately 10 pounds of scratch grain and 10 pounds of mash daily, while Plymouth Rocks and similar breeds require 12 pounds each of scratch grain and mash daily per 100 birds. The feeding of the scratch ration should be so regulated that the birds will consume approximately the same quantity of mash

and scratch feed during the year. It is advisable, however, to feed more scratch than mash in the fall, about equal parts of each late in winter and spring, and more mash than scratch in the summer. More grain is consumed during seasons of heavy egg production than at other times. This is an important point to be kept in mind, because a decrease in egg production sometimes occurs when the fowls consume less grain than usual. Feeding extra scratch grains in hoppers in the fall as the last feed of the day helps to keep the pullets in good condition. The condition of the birds should be watched carefully and every effort made to keep them in good physical condition without getting them too fat.

FIGURE 8.—Yards for breeding pens on a southern poultry farm where the breeders are supplied with an abundance of alfalfa

FEEDING BREEDING STOCK

The breeding stock needs special attention in feeding if hatching eggs of the highest possible quality are to be obtained. The ration for breeders should have somewhat less corn meal and meat scrap than the ration for layers. On the other hand, milk, minerals, and green feed (fig. 8) are of particular importance in the breeding ration. Also, it is very important to have an abundance of vitamins in the ration, and 1 to 2 per cent of cod-liver oil added to the mash will enable the breeders to utilize the minerals in the ration. Direct sunlight is very beneficial and all breeders should be allowed outdoors as much as possible during the breeding season. If snow covers the ground, the windows of the poultry house should be kept open as much as possible.

Table 1 gives the average composition of all feeds commonly used for poultry. It should be remembered that grains produced in different sections vary considerably in composition. These variations do not greatly affect the rations except for the variations in the high-protein products, such as meat scrap, fish meal, tankage, and dried milk. Variations of more than 50 per cent in the protein content of different grades of these high-protein feeds often occur, which materially affects the composition of the ration.

TABLE 1.—*Composition of feeds*

Feed	Moisture	Ash	Crude protein	Carbohydrates		Fat, or ether extract
				Crude fiber	Nitrogen-free extract	
GRAINS AND SEEDS	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*
Barley	9.6	2.9	12.8	5.5	66.9	2.3
Barley meal	9.6	2.9	12.8	5.5	66.9	2.3
Bread	33.8	1.5	7.9	.7	55.4	.7
Brewers' grain (dried)	6.8	3.6	26.9	14.3	41.4	7.0
Broomcorn	11.8	2.9	10.2	8.2	63.5	3.4
Buckwheat	12.6	2.0	10.0	8.7	64.5	2.2
Buckwheat middlings	12.0	4.8	28.3	4.8	42.7	7.4
Coconut meal (O. P.)	7.3	5.5	21.3	9.4	46.5	10.0
Corn	12.9	1.3	9.3	1.9	70.3	4.3
Corn bran	10.3	2.4	9.9	10.4	59.7	7.3
Ground ear corn	15.6	1.5	8.3	6.8	64.4	3.4
Corn-gluten feed	9.2	3.6	25.1	7.3	51.9	2.9
Corn-gluten meal	9.0	1.3	40.9	3.2	44.5	1.1
Corn meal or chops	12.9	1.3	9.3	1.9	70.3	4.3
Cottonseed meal (prime)	6.9	5.9	38.8	12.2	29.4	6.8
Cowpeas	9.8	3.6	23.8	4.3	57.1	1.4
Durra	9.9	2.0	10.1	1.7	72.8	3.5
Feterita	11.1	1.5	12.5	1.7	70.1	3.1
Field peas	9.2	3.4	22.9	5.6	57.8	1.1
Flaxseed	9.2	4.3	22.6	7.1	23.2	33.7
Flour middlings	10.7	3.7	17.8	4.7	58.1	5.0
"Red Dog" flour	10.1	2.9	17.2	3.1	61.9	4.8
Garden peas	11.8	3.0	25.6	4.4	53.6	1.6
Hempseed	8.0	2.0	10.0	14.0	45.0	21.0
Hominy feed	8.3	2.9	10.9	4.6	65.6	7.7
Kafir	9.4	1.6	11.1	2.1	72.6	3.2
Linseed meal (O. P.)	8.9	5.4	34.5	7.7	36.7	6.8
Malt sprouts	7.8	5.7	25.9	12.4	46.9	1.3
Millet	10.8	3.6	12.1	8.4	61.0	4.1
Milo	10.7	2.8	10.7	2.4	70.5	2.9
Navy beans	13.4	3.6	22.7	5.8	53.0	1.5
Oats or ground oats	7.7	3.5	12.5	11.2	60.7	4.4
Peanuts (hulls on)	6.0	2.8	24.7	18.0	15.4	33.1
Peanut kernels	5.5	2.3	30.2	2.8	11.6	47.6
Peanut meal (no hulls)	6.2	4.9	49.3	6.3	22.5	10.8
Rice (polished)	12.3	.5	7.4	.4	79.0	.4
Rye	9.5	1.9	11.1	2.1	73.7	1.7
Rye feed	10.2	4.0	15.6	4.3	62.7	3.2
Soybeans	6.4	4.8	39.1	5.2	25.8	18.7
Soybean meal	6.1	5.6	47.1	5.7	27.7	7.8
Shallu	9.7	1.6	12.5	1.7	71.1	3.4
Sunflower seed	6.9	3.1	16.1	27.9	21.3	24.7
Velvet beans	9.8	3.1	26.2	6.0	50.1	4.8
Wheat	10.6	1.8	12.3	2.4	71.1	1.8
Wheat bran	9.6	5.9	16.2	8.5	55.6	4.2
Wheat flour	12.3	.5	10.9	.4	74.6	1.3
Wheat middlings (shorts)	10.1	3.5	16.3	4.3	61.6	4.2
Wheat screenings	10.2	3.9	13.3	7.4	61.1	4.1
FEEDS OF ANIMAL ORIGIN						
Blood meal	9.7	3.3	82.3	----------	3.8	.9
Bone meal	7.2	61.5	23.1	3.3	----------	4.9
Bone meal (steamed)	4.1	70.0	4.9	----------	----------	.5
Buttermilk	91.0	.7	3.0	----------	4.8	.5
Buttermilk, condensed	71.5	3.3	11.5	----------	10.4	3.3
Buttermilk, dried	4.5	8.1	34.6	----------	48.3	4.5
Fish meal	6.6	21.0	56.1	.7	2.6	10.5
Fresh bone	30.4	21.1	19.7	----------	3.8	25.0
Meat scrap (50 to 55 per cent protein)	7.1	21.1	53.9	2.2	5.0	10.7
Pork cracklings	5.0	2.3	56.4	----------	4.1	32.2
Skim milk	90.6	.7	3.2	----------	5.2	.3
Skim milk, dried	4.7	7.3	37.0	----------	50.0	1.0
Tankage	7.6	22.2	53.7	1.8	3.8	10.9
Whey	93.8	.4	.6	----------	5.1	.1
GREEN FEEDS, ETC.						
Alfalfa (green)	72.9	2.6	4.7	8.0	11.0	.8
Alfalfa-leaf meal	5.6	14.2	20.5	15.2	41.1	3.2
Alfalfa meal or alfalfa hay (dried)	8.3	8.9	16.0	27.1	37.1	2.6
Beet pulp (dried)	8.4	3.5	9.3	18.7	59.3	.8
Cabbage	91.1	.8	2.2	.9	4.7	.3
Cane molasses	24.5	6.8	3.1	----------	66.1	----------
Carrots	88.6	1.0	1.1	1.3	7.6	.4
Kale	88.7	1.9	2.4	1.5	5.0	.5
Mangels	91.2	1.0	1.4	.8	5.4	.2
Potatoes	78.9	1.0	2.1	.6	16.3	.1
Rape	85.7	2.0	2.4	2.2	7.1	.6
Red-clover hay (dried)	12.9	6.9	13.6	24.1	39.1	3.4
Rutabagas	88.6	1.2	1.2	1.3	7.5	.2
Turnips	90.6	.8	1.3	1.2	5.9	.2

U. S. GOVERNMENT PRINTING OFFICE: 1930

For sale by the Superintendent of Documents, Washington, D. C. - - - - Price 5 cents